



UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/773,184	02/09/2004	Kia Silverbrook	MTB36US	8429

24011 7590 11/29/2007
SILVERBROOK RESEARCH PTY LTD
393 DARLING STREET
BALMAIN, 2041
AUSTRALIA

EXAMINER

FIDLER, SHELBY LEE

ART UNIT	PAPER NUMBER
----------	--------------

2861

MAIL DATE	DELIVERY MODE
-----------	---------------

11/29/2007

PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No. 10/773,184	Applicant(s) SILVERBROOK, KIA	
	Examiner Shelby Fidler	Art Unit 2861	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 02 October 2007.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-8, 10-22, 24-27, 29-44 and 46-54 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-8, 10-22, 24-27, 29-44 and 46-54 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. _____.
 3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|--|---|
| 1) <input type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413) |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | Paper No(s)/Mail Date. _____ |
| 3) <input checked="" type="checkbox"/> Information Disclosure Statement(s) (PTO/SB/08) | 5) <input type="checkbox"/> Notice of Informal Patent Application |
| Paper No(s)/Mail Date <u>8/15/07</u> . | 6) <input type="checkbox"/> Other: _____ |

DETAILED ACTION

Responsive Office Action

This Office Action is responsive to the remarks and amendments filed 10/2/2007.

Terminal Disclaimer

The terminal disclaimer filed on 10/2/2007 disclaiming the terminal portion of any patent granted on this application which would extend beyond the expiration date of the full statutory term of any patent granted on pending reference Application Number 10/773183, filed 9 February 2004, has been reviewed and is accepted. The terminal disclaimer has been recorded.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

Claims 1-2, 4-5, 7, 11-13, 16, 19-20, 22, 24, 26, 30-32, 35, 38-39, 41-42, 48-50, and 52 are rejected under 35 U.S.C. 103(a) as being unpatentable over Campbell et al. (US 4870433) in view of Sakurai et al. (US 5206659).

Regarding claims 1, 19, and 38:

Campbell et al. disclose an inkjet printhead comprising:

a plurality of nozzles (nozzles 19), each defining a nozzle aperture having a central axis (the axis penetrating the center of the nozzle opening in Figs. 1 and 2);

a bubble forming chamber (print cavity 21) corresponding to each of the nozzles respectively (Fig. 2);

at least one heater element (resistive heater elements 12) disposed in each of the bubble forming chambers respectively (Fig. 2), the heater element being configured for thermal contact with a bubble forming liquid (col. 3, lines 8-11); such that

heating the heater element to a temperature above the boiling point of the bubble forming liquid forms a gas bubble (bubble 22) that causes the ejection of a drop of an ejectable liquid through the nozzle corresponding to that heater element (col. 3, lines 8-13); wherein

the heater element is spaced from the central axis (Figs. 1 and 3), defines a current path substantially around the central axis (Fig. 3), and has a bubble nucleation section (elongated portions 31) defined about the central axis (Fig. 3).

Campbell et al. do not expressly disclose that the heater element has a bubble nucleation section of a smaller cross section than the rest of the heater element so that the temperature of the bubble nucleation section is heated to above the boiling point before the rest of the heater element.

However, Sakurai et al. disclose heater elements (heater arrangement 50) that have bubble nucleation sections (heating element 56) of a smaller cross section than the rest of the heater element (Fig. 5A) so that the temperature of the bubble nucleation section is heated to above the boiling point before the rest of the heater element (col. 5, lines 1-8, 19-40 and Figs. 5 and 6).

Therefore, at the time of invention, it would have been obvious to a person of ordinary skill in the art to utilize heater elements with bubble nucleation sections of a smaller cross section, such as taught by Sakurai et al., into the invention of Campbell et al. The motivation for doing so, as taught by Sakurai et al., is to provide a heater element that can withstand high heating rates while also providing a high heat flux transfer to the ink (col. 5, lines 19-46).

Regarding claims 2, 20, and 39:

Campbell et al. also disclose that the bubble forming chamber (21) has a circular cross section (Figs. 1 and 2) and the heater element (12) has arcuate sections (e.g. inside portions of end portions 32) that are concentric with the circular cross section (Fig. 3).

Regarding claims 4, 22, and 41:

Campbell et al. also disclose that the heater element (12) is ring shaped (Fig. 3) and extends between electrodes (control electrode 16 and common electrode 15) mounted on opposite sides of the bubble forming chamber (Figs. 2 and 3).

Regarding claims 5, 24, and 42:

Campbell et al. also disclose that the bubble forming liquid and the ejectable liquid are of a common body of liquid (col. 3, lines 8-13).

Regarding claims 7 and 26:

Campbell et al. as modified by Sakurai et al. disclose all claimed limitations except that the heater element is predominantly formed from titanium nitride.

However, Sakurai et al. disclose forming a heater element from alloys, oxides, nitrides, or borides of titanium, tantalum, tungsten, niobium, chromium, hafnium, zirconium, or nickel (col. 4, lines 65-68).

Therefore, at the time of invention, it would have been obvious to a person of ordinary skill in the art to utilize a heater element predominantly of Titanium Nitride, such as suggested by Sakurai, into the invention of Campbell et al. as modified by Sakurai et al. The motivation for doing so, as taught by Sakurai et al., is to provide a heater element made of a material that disperses the undesirable thermal stresses that are induced in a heating element (col. 5, lines 1-8).

Regarding claims 11, 30, and 47:

Campbell et al. also disclose that each heater element (12) has two opposite sides (e.g. top side and bottom side of Fig. 3) and is configured such that the gas bubble formed by the heater element is formed at both sides of the heater element (col. 3, lines 50-60 and Fig. 3).

Regarding claims 12, 31, and 48:

Campbell et al. also disclose that the bubble (22) is collapsible and has a point of collapse, and wherein each heater element (12) is configured such that the point of collapse is spaced from any solid surface of the heater elements (col. 3, lines 60-64).

Regarding claims 13, 32, and 50:

Campbell et al. also disclose a structure (substrate 18), wherein the nozzles (19) are incorporated on the structure (col. 3, lines 1-3 and Fig. 2).

Examiner notes the limitation that the structure is formed by chemical vapor deposition. However, this limitation pertains only to the method of forming a device, which is not germane to the patentability of the device itself or the method of using the device; therefore, Examiner has not given this limitation patentable weight.

Regarding claims 16, 35, and 52:

Campbell et al. as modified by Sakurai et al. disclose all claimed limitations except that the heater element is formed of solid material more than 90% of which, by atomic proportion, is constituted by at least one periodic element having an atomic number below 50.

However, Sakurai et al. disclose forming a heater element from alloys, oxides, nitrides, or borides of titanium, tantalum, tungsten, niobium, chromium, hafnium, zirconium, or nickel (col. 4, lines 65-68).

Therefore, at the time of invention, it would have been obvious to a person of ordinary skill in the art to utilize a heater element formed of Titanium Nitride (90% constituted by periodic element Titanium), such as suggested by Sakurai, into the invention of Campbell et al. as modified by Sakurai et al. The motivation for doing so, as taught by Sakurai et al., is to provide a heater element made of a material that disperses the undesirable thermal stresses that are induced in a heating element (col. 5, lines 1-8).

Claims 3, 21, and 40 are rejected under 35 U.S.C. 103(a) as being unpatentable over Campbell et al. as modified by Sakurai et al., as applied to claims 2, 20, and 39, and further in view of Moon et al. (US 6761433 B2).

Regarding claims 3, 21, and 40:

Campbell et al. as modified by Sakurai et al. disclose all claimed limitations except that the heater element is omega-shaped and extends between adjacent electrodes in the side of a bubble forming chamber.

However, Moon et al. disclose a heater element (resistors 104) that is omega-shaped (Fig. 5A) and extends between adjacent electrodes (electrodes 105) in the side of a bubble forming chamber (col. 2, lines 34-37 and Fig. 9).

Therefore, at the time of invention, it would have been obvious to a person of ordinary skill in the art to utilize an omega-shaped heater element into the invention of Campbell et al. as modified by Sakurai et al. The motivation for doing so, as taught by Moon et al., is to provide another embodiment of a resistor that is spaced from the central axis of the nozzle (col. 6, lines 4-8) and to produce bubbles that coalesce at the center of the nozzle, thereby preventing satellite droplets (col. 11, lines 42-46).

Claims 6, 8, 10, 14, 25, 27, 29, 33, 43-44, 46, and 49 are rejected under 35 U.S.C. 103(a) as being unpatentable over Campbell et al. as modified by Sakurai et al., as applied to claim 1 above, and further in view of Silverbrook (US 6019457).

Regarding claims 6, 25, and 43:

Campbell et al. as modified by Sakurai et al. disclose all claimed limitations except that the printhead is configured as a pagewidth printhead.

However, Silverbrook discloses a pagewidth printhead (head 200) configured to print on a page (col. 6, lines 7-12).

At the time of invention, it would have been obvious to a person of ordinary skill in the art to utilize a pagewidth printhead into the invention of Campbell et al. as modified Sakurai et al. The motivation for doing so, as taught by Silverbrook, is to be able to print on the width of an A4 page (col. 6, lines 7-12).

Regarding claims 8, 27, and 44:

Campbell et al. as modified by Sakurai et al. disclose all claimed limitations except that the heater elements are configured such that an actuation of less than 500 nJ is required to be applied to the heater elements so as to form the bubble in the bubble forming liquid to cause the ejection of the drop.

However, Silverbrook discloses heater elements (heaters 120; Fig. 10) that are configured such that an actuation energy of less than 500 nJ is required to heat the heater element sufficiently to form the bubble in the bubble forming liquid, thereby causing an ejection of the drop (200 nJ; col. 19, lines 8-9).

At the time of invention, it would have been obvious to a person of ordinary skill in the art to utilize heater elements that require less than 500 nJ to heat the heater element to eject a drop into the invention of Campbell et al. as modified by Sakurai et al. The motivation for doing so, as taught by Silverbrook, is to allow power dissipation to be reduced without affecting print speed (col. 19, lines 9-10).

Regarding claims 10, 29, and 46:

Campbell et al. as modified by Sakurai et al. disclose all claimed limitations except that the substrate surface has an areal density of nozzles exceeding 10,000 nozzles per square centimeter of substrate surface.

However, Silverbrook discloses a substrate surface wherein the areal density of the nozzles relative to the substrate surface exceeds 10,000 nozzles per square centimeter of substrate surface (using the reference measurement of Figure 43 and counting the individual

nozzles disclosed in the "part of cyan" section of Figure 43, calculations show that the density

exceeds 10,000 per square centimeter: $\frac{20 \text{ nozzles}}{0.0016384 \text{ cm}^2} = 12207 \frac{\text{nozzles}}{\text{cm}^2}$).

At the time of invention, it would have been obvious to a person of ordinary skill in the art to utilize a printhead substrate surface with a nozzle density of 10,000 nozzles per square centimeter into the invention of Campbell et al. as modified by Sakurai et al. The motivation for doing so, as taught by Silverbrook, is to provide four nozzles per pixel which would give up to 16 drops per pixel (co. 16, lines 60-62).

Regarding claims 14, 33, and 49:

Campbell et al. as modified by Sakurai et al. disclose all the limitations of claim 1, and Campbell et al. also disclose a structure (substrate 18), wherein the nozzles (19) are incorporated on the structure (col. 3, lines 1-3 and Fig. 2).

Campbell et al. as modified by Sakurai et al. do not expressly disclose that the structure is less than 10 microns thick.

However, Silverbrook discloses a structure (overcoat 142) that is less than 10 microns thick (col. 9, lines 8-10), wherein nozzles are incorporated on the structure (Fig. 11).

At the time of invention, it would have been obvious to a person of ordinary skill in the art to utilize a structure incorporating nozzles that is less than 10 microns thick into the invention of Campbell et al. as modified by Sakurai et al. The motivation for doing so, as taught by Silverbrook, is to provide increased levels of protection against the air (col. 9, lines 5-8).

Claims 15, 18, 34, 37, 51, and 54 are rejected under 35 U.S.C. 103(a) as being unpatentable over Campbell et al. as modified by Sakurai et al., as applied to claim 1 above, and further in view of Kubby (US 5851412).

Regarding claims 15, 34, and 51:

Campbell et al. as modified by Sakurai et al. disclose all the limitations of claim 1, and Campbell et al. also disclose that the printhead comprises a plurality of bubble forming chambers (col. 2, lines 48-53) each corresponding to a respective nozzle (Fig. 2)

Campbell et al. as modified by Sakurai et al. do not expressly disclose a plurality of heater elements are disposed within each bubble forming chamber, the heater elements within each bubble forming chamber being formed on different respective layers to one another.

However, Kubby discloses a plurality of heater elements (doped regions 20) disposed within a bubble forming chamber (Figs. 4 and 5), the heater elements within each bubble forming chamber being formed on different respective layers to one another (col. 4, line 66 – col. 5, line 10).

Therefore, at the time of invention, it would have been obvious to a person of ordinary skill in the art to utilize a plurality of heater elements formed on different layers within each bubble forming chamber, such as taught by Kubby, into the invention of Campbell et al. as modified by Sakurai et al. The motivation for doing so, as taught by Kubby, is to provide an ink jet ejector that is capable of emitting two distinct droplet sizes (col. 5, lines 11-21).

Regarding claims 18, 37, and 54:

Campbell et al. as modified by Sakurai et al. disclose all claimed limitations except that each heater element is covered on all sides with a conformal protective coating such that the coating of each heater element is seamless.

However, Kubby discloses heater elements that are covered on all sides with a conformal protective coating (protective layer of tantalum) such that the coating of each heater element is seamless (col. 4, lines 60-62 and Fig. 4).

Examiner notes the additional limitation that the coating is applied substantially to all sides of the heater element simultaneously. However, the method of forming a device is not germane to the issue of patentability of the device itself. Therefore, this limitation has not been given patentable weight.

Therefore, at the time of invention, it would have been obvious to a person of ordinary skill in the art to utilize a seamless protective coating on all sides of the heater element, such as taught by Kubby, into the invention of Campbell et al. as modified by Sakurai et al. The motivation for doing so, as taught by Kubby, is to prevent corrosion of the semiconductor structures caused by contact with liquid ink (col. 4, lines 37-39).

Claims 17, 36, and 53 are rejected under 35 U.S.C. 103(a) as being unpatentable over Campbell et al. as modified by Sakurai et al., as applied to claim 1 above, and further in view of DeMoor et al.

Regarding claims 17, 36, and 53:

Campbell et al. as modified by Sakurai et al. disclose all claimed limitations except that the heater element is configured for a mass of less than two nanograms of the solid material

of the heater element to be heated to a temperature above the boiling point to heat the bubble forming liquid to a temperature above the boiling point to cause the ejection of a drop.

However, DeMoor et al. disclose using a heater element of less than 2 nanograms (page 285, Fabrication: Ti thickness = 5nm; TiN thickness = 30nm; heater width = 2000 μ m; heater width = 0.4 μ m. Therefore, the volume of Ti within the heater is 4×10^{-12} cm³, and the volume of TiN within the heater is 2.4×10^{-11} cm³. Using the known densities of Ti = 4.54 g/cm³ and TiN = 5.22 g/cm³, the heater element has an entire mass of 0.14344 ng).

Therefore, at the time of invention, it would have been obvious to a person of ordinary skill in the art to utilize a heater element of less than 2 nanograms, such as taught by DeMoor et al., into the invention of Campbell et al. as modified by Sakurai et al. The motivation for doing so, as taught by DeMoor et al., is that these types of heaters show excellent resistivity uniformity and a low TCR value (page 293, Conclusions).

Response to Arguments

Applicant's arguments filed 10/2/2007 have been fully considered but they are not persuasive.

Applicant argues, regarding claim 1, that the combination of Campbell et al. (hereinafter "Campbell") as modified by Sakurai et al. (hereinafter "Sakurai") does not disclose a heater element with a bubble nucleation section that has a smaller cross section than the rest of the heater element so that the temperature of the bubble nucleation section is heated to above the boiling point before the rest of the heater element. Specifically, Applicant argues that the heating element 56, not the heating arrangement 50, of Sakurai would correspond to the

claimed "heater element". Therefore, Applicant explains, the claimed limitation is not disclosed by the combination, since Sakurai does not disclose a heating element 56 that fulfills the currently amended claim language. Examiner respectfully disagrees.

The previous Office Action dated 7/5/2007 uses Campbell et al. to disclose a majority of the limitations found in claim 1. In that Action, Examiner indicates that Campbell's resistive heater element 12 corresponds to the claimed "at least one heater element". As shown in Figure 3 of Campbell, the heater element 12 comprises not only elongate portions 31 (corresponding to the claimed "bubble nucleation sections"), but also the individual and common electrodes 15 and 16. Then, Examiner relied upon Sakurai to show that it would have been obvious to modify Campbell's heater element 12 so that the elongate portions 31 have a smaller cross section than the rest of the heater element (including electrodes 15 and 16), such that the elongate portions 31 are heated to above the boiling point before the rest of the heater element 12. Sakurai shows that this would have been obvious by disclosing a heater arrangement 50 that includes not only heating elements 56 (corresponding to the claimed "bubble nucleation Sections"), but also electrodes 58a and 58b. Here, the heating currents are concentrated within the heating element 56, but disperse at the boundaries of the heating element 56 that connect to the electrodes 58a and 58b (col. 5, lines 1-18). Because the heating currents are more concentrated within the heating element 56 portion of the heater arrangement 50, the heating element 56 is configured to reach the boiling point before the rest of the heater arrangement 50.

Examiner notes that the flow of current through any material will heat that material according to magnitude of the current and the material's properties. Therefore, Campbell's

entire heating element, including elongate portions 31 and electrodes 15 and 16, is heated upon receipt of current.

Therefore, in light of the disclosures provided by Campbell and Sakurai, all the currently amended claim limitations have been properly disclosed by the combination of Campbell as modified by Sakurai.

Conclusion

THIS ACTION IS MADE FINAL. Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire **THREE MONTHS** from the mailing date of this action. In the event a first reply is filed within **TWO MONTHS** of the mailing date of this final action and the advisory action is not mailed until after the end of the **THREE-MONTH** shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than **SIX MONTHS** from the mailing date of this final action.

Communication with the USPTO


Any inquiry concerning this communication or earlier communications from the examiner should be directed to Shelby Fidler whose telephone number is (571) 272-8455. The examiner can normally be reached on M-F 8:30-5:00.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Matthew Luu can be reached on (571) 272-7663. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

Shelby Z. Fidler 11/21/2007

Shelby Fidler
Patent Examiner
AU 2861


MATTHEW LUU
SUPERVISORY PATENT EXAMINER